UNIT 7:
PERSONAL PROTECTIVE EQUIPMENT

LEARNING OBJECTIVES

By the end of this unit, participants will be able to:

- Explain the advantages and limitations of various types of personal protective equipment
- Describe the types of respiratory equipment
- Explain the limitations of self-contained breathing apparatus (SCBA)
- Describe decontamination procedures

TYPES OF PROTECTIVE EQUIPMENT

Structural fire fighting clothing and equipment should not be used for hazardous materials incidents. The only possible exception to this may be incidents that involve gasoline spills. In this case, follow your own department's standard operating procedures.

NFPA Standards

The National Fire Protection Association (NFPA) has issued three standards on protective clothing for fire fighters. Each of these standards is described below.

NFPA 1991

NFPA 1991 is the standard on vapor-protective suits for hazardous chemical emergencies. It represents the highest level of protection and covers the use of vapor-protective suits that are generally used only by hazardous materials team members. Vapor-protective suits should not be used for fire fighting or in flammable or explosive situations. Nor should they be used where there are biological, cryogenic, or radioactive hazards.

Emergency responders in vapor-protective suits

NFPA 1992

NFPA 1992 defines performance criteria for suits that provide protection from chemical splashes only. Although liquid splash-protective suits can be used in the hot zone, they should not be used in situations where vapor or gas hazards are present. In many instances, liquid splash protective suits are also adequate for decontaminating entry personnel in vapor-protective suits.

Emergency responder in liquid splash protective suit, going through a decontamination process

NFPA 1993

This standard applies only to personnel working outside the hot zone in support functions. This type of protective clothing can be used only if the site has been characterized and chemical hazards are insignificant. For fire fighters, “support function” can refer to structural fire fighting gear. However, the standard does not cover the face shield, gloves or boots unless they are an integral part of the garment.

Typical structural fire fighting gear with SCBA

Structural Fire Fighting Gear

Structural fire fighting gear is designed to protect fire fighters from heat and flame. The coats are generally made of three layers.

- The outer layer provides durability, tear resistance, and some thermal protection, and is typically reinforced with Kevlar and Nomex
- The middle layer is usually made of a waterproof mate-rial, designed as a moisture barrier
- The inner layer is designed for thermal protection only, and may also be covered with Nomex or Kevlar

There is no layer or component designed to protect against any type of chemical.

Chemical protective clothing, on the other hand, typically provides no thermal protection. Instead, this clothing is resistant to specific chemicals, depending on the material that makes up the suit.

Protective suits may be constructed to keep out gases and vapors (fully encapsulated, vapor-protective) or to prevent exposure to liquids (liquid splash-protective).

RESPIRATORY EQUIPMENT

Because inhalation is one of the major routes of exposure to chemicals, respiratory protection is extremely important. Most First Responders use self-contained breathing apparatus (SCBA) as the primary means of respiratory protection.

SCBA usually consists of a facepiece connected by a hose to a regulator. The regulator is connected to an air source carried by the wearer. SCBAs offer protection against many types and levels of airborne contaminants.

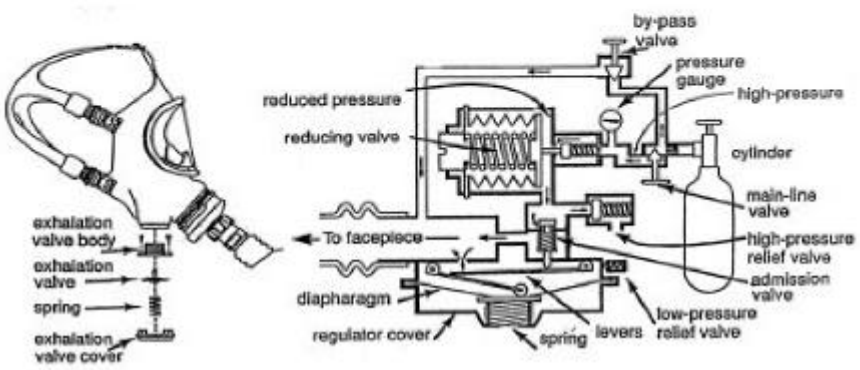
Only positive-pressure SCBAs and supplied air respirators (SARs) should be used in emergency response. SCBAs maintain a positive pressure in the facepiece during inhalation and exhalation. Some other types of breathing apparatus such as air purifying respirators do not. Both SCBA and SAR facepieces should be fit-tested before use.

Air purifying respirators are unsuitable for emergency response. While cartridges on the respirator's mask filter contaminants in the environment, there is no supply of air. If the environment is oxygen-deficient, then the air taken in through the mask is oxygen-deficient as well. This could be extremely hazardous in an environment where oxygen is being displaced or consumed, as in combustion. Also, the user must know the type and concentration of material present in order to select the appropriate cartridge for the atmosphere.

Self-Contained Breathing Apparatus

SCBAs are extensively regulated by federal legislation. Federal regulations require that these devices be tested and approved by the Mine Safety and Health Administration (MSHA) and by the National Institute of Occupational Safety and Health (NIOSH). The following diagram shows typical SCBA components.

Typical SCBA Components



Inspection and Storage

Inspect your PPE and store it properly to keep it in good condition. Good care minimizes repairs and extends the life of your equipment.

The sample inspection checklist on the following page can serve as an initial guide for developing more extensive procedures.

TABLE 7.1 SAMPLE PPE INSPECTION CHECKLIST

SCBA	TURNOUT GEAR

• Check that all connections are tight
• Check materials (including harness and straps) for pliability, signs of deterioration, and signs of distortion
• Check for proper setting and operation of regulators and valves (according to manufacturer's recommendations)
• Check that bottle is securely fastened to pack/holder and is full
• Check hydrostatic test date for bottle
• Check operation of alarm(s), check P.A.S.S. device if attached to SCBA
• Examine face shield and lenses for cracks and fogginess
• Inspect SCBAs: daily or at shift change; before and after each use; at least monthly when in storage; every time they are cleaned
	Coats and Trousers:
	• Examine outer shell, liner materials, wristlets, collars, and hoods for evidence of:
	  • Contamination: soiling, stains, discoloration, deterioration
	  • Physical damage: tears, cuts, punctures, abraded areas
	  • Thermal damage: brittleness, charring, stiffness, melted areas
	• Check stretch recovery of hood and wristlet materials
	• Examine condition of all seams, looking for loose stitching or lifted tape of moisture barrier seams
	• Examine hardware (snaps, hooks and dees, zippers) for signs of corrosion
	• Examine trim for loss of luster, abraded areas, and evidence of melting
	• Inspect after cleaning
	Helmets:
	• Examine shell for: discoloration, pitting, separation, impact/puncture damage, and evidence of melting
	• Examine face shield for: scratches, cloudiness, and evidence of melting
	• Examine retention/suspension system for discoloration, evidence of thermal damage, and physical defects
	• Examine helmet hardware for corrosion and trim for loss of luster, abraded areas, and evidence of melting
	• Inspect after cleaning
	Gloves:
	• Examine outer shell and liner materials and wristlets for evidence of damage and contamination
	• Examine condition of all seams, looking for loose stitching or lifted tape of moisture barrier seams; check to ensure that liner has not separated from outer shell
	Footwear:
	• Examine boot outer and liner materials for evidence of damage and contamination
	• Examine condition of soles for punctures, cuts, or embedded items (for example, nails)
	• Examine hardware (eyelets, stud posts, zippers) for signs of corrosion

DECONTAMINATION

Decontamination or “contamination reduction” is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. This process is critical to health and safety at hazardous materials response incidents.

Fire fighter in liquid splash protective gear undergoing decontamination

Decontamination protects responders from hazardous substances that may contaminate and eventually permeate their protective clothing, respiratory equipment, tools, vehicles, and other equipment used at the emergency scene. It also minimizes the transfer of harmful materials into non-contaminated clean areas, helps prevent mixing of incompatible chemicals, and protects the community by preventing movement of contaminants from the site.

Preventing Contamination

To prevent contamination, you should establish work practices and standard operating procedures that minimize contact with hazardous substances. At an emergency scene, for example, avoid leaks, spills, and obvious sources of hazards, as well as indirect contact with potentially contaminated surfaces.

Types of Contamination

Contaminants may be located on the surface of personal protective equipment or may have permeated into the PPE material. Surface contaminants are often easy to detect and remove; however, contaminants that have permeated a material are difficult or impossible to detect and remove. If contaminants that have permeated a material are not removed by decontamination, ongoing exposure may result.

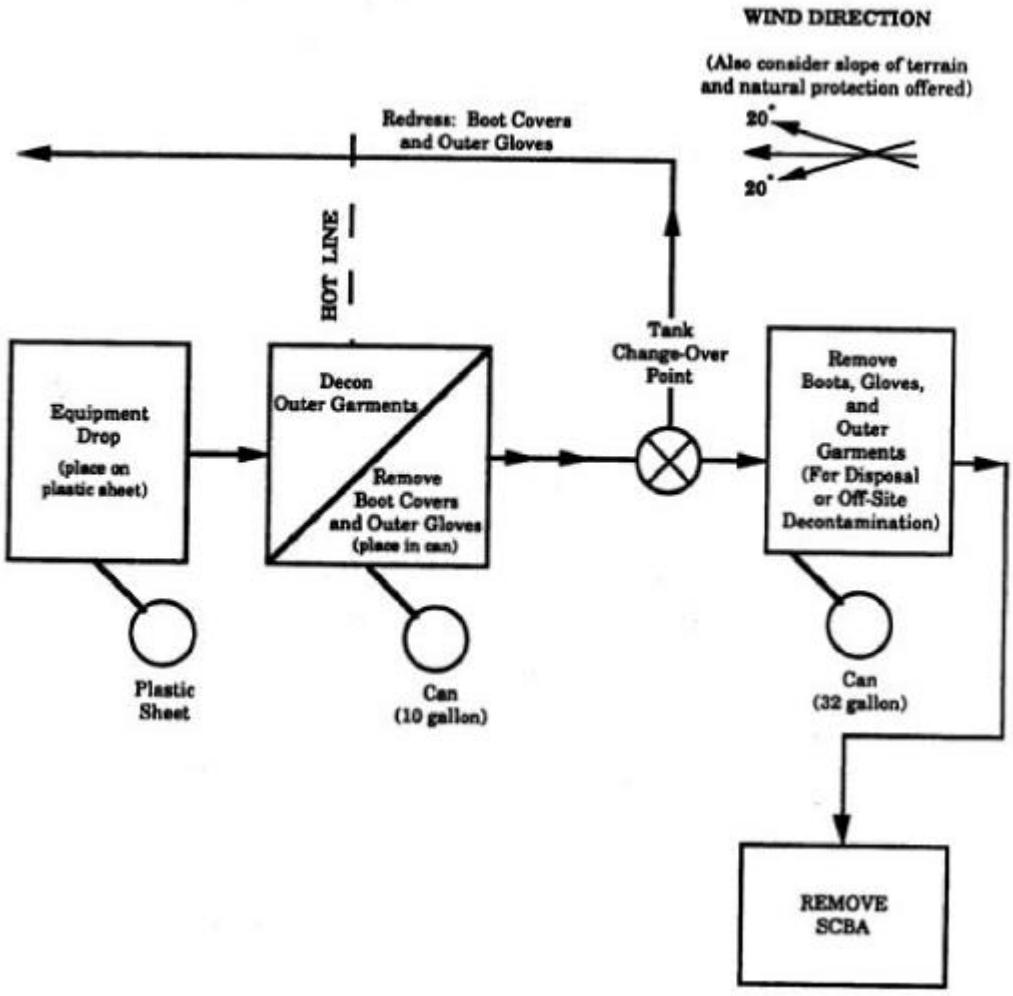
Decontamination Methods

All personnel, clothing, equipment, and samples leaving the Hot Zone (where there is potential exposure to hazardous materials) must be decontaminated to remove any harmful chemicals or infectious organisms. Decontamination methods physically remove contaminants, disinfect biologic contaminants, or remove contaminants by a combination of physical and chemical means. Decontamination allows the responder to safely remove the protective clothing.

Decontamination Plan

A decontamination area must be set up before any personnel or equipment enter areas where the potential for exposure to hazardous substances exists. Decontamination procedures provide an organized process by which levels of contamination are reduced. This process is a series of procedures performed in a specific sequence. For example, outer, more heavily contaminated items (e.g., outer boots and gloves) should be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (e.g., jackets and pants). A *minimum* decontamination layout is shown on the following page.

Decontamination Plan



ll equipment used for decontamination must also be decontaminated and/or disposed of properly. Buckets, brushes, clothing, tools, and other contaminated equipment should be collected, placed in containers, and labeled. Also, all spent solutions and wash water should be collected and disposed of properly. Clothing that is not completely decontaminated should be placed in plastic bags pending further decontamination and/or disposal.

Emergency Decontamination

In addition to routine decontamination procedures, emergency decontamination procedures must be established. In emergency decontamination, the primary concern is to prevent severe injury or loss of life. At the same time, contaminants must be removed to prevent ongoing exposure to the patient and exposure to response personnel through secondary contamination. Even in an emergency, decontamination should follow a specific sequence.

Outer, more heavily contaminated items are decontaminated and removed first, followed by less contaminated articles of clothing. Gloves and boots or shoes may require more extensive decontamination than shirts or jackets. In cases where the victim is wearing street clothing or other materials that are not easily decontaminated, the outer clothing should be removed.

Dry contaminants should be brushed off the skin. Liquid contaminants can be blotted dry. Care must be taken to keep all contaminants away from the face and open wounds. Affected skin and mucous membranes (including the eyes) should be flushed with lukewarm water for at least 15 minutes. Cold water can be used if lukewarm water is not available. Large amounts of water must be used when corrosives are involved.